

## BOOK REVIEW

*The Evolution and Classification of Flowering Plants* by Arthur Cronquist, Senior Curator, The New York Botanical Garden. Houghton Mifflin Company, Boston. 1968. i-xii, 1-396, with glossary. \$6.95.

As the title implies, this book is conveniently divided into two sections. The first, which amounts to approximately one-third of the work, is concerned with taxonomic principles, the origin of the angiosperms, and the evolution of characters. The second and by far the longer section is devoted to the author's classification of the angiosperms (Magnoliophyta) and to explaining in some detail his reasoning in erecting the proposed system.

The first chapter deals with certain taxonomic concepts such as the natural system, character values, monophyly, parallelism, survival value (adaptive significance) of certain characters, and the grouping and ranking of taxa. This chapter, as the other two in the first section, ends with a short list of selected references. In general, the discussion is interesting, although the topics are highly selective.

One might disagree that the best definition of taxonomy is "a study aimed at producing a system of classification of organisms which best reflects the totality of their similarities and differences", even though the author readily admits that "taxonomy might be variously defined, according to the definer . . .".

A biochemist might also disagree with the statement that we know perhaps more about man than about any other species in light of the recent statement of one molecular biologist that we now know at least one-fifth and maybe more than one-third of all the chemical reactions in *Escherichia coli*.

On the other hand a palynologist might take the author to task for the statement on page six that identifications of fossil pollen "cannot provide new or independent information on the evolutionary diversification of a group, or on the transitions between groups; they merely document the existence of a modern group at a particular time in the past".



Among the major conclusions of this chapter are the following: taxonomy is based on multiple correlations, character value is determined *a posteriori*, the presence of a character is likely to be more important than its absence, and a proper taxonomic system must reflect evolutionary relationships.

The second chapter very briefly characterizes the angiosperms, reviews the fossil record (or lack of it), and surveys the groups that have been suggested as possible angiosperm precursors: conifers, the Gnetales, and various cycadophytes — cycads, the Bennettitales, the Caytoniales, and the seed ferns. After eliminating most of the above groups as potential ancestors, the author concludes, as so many others have in the past, that although there is a vast abyss between the seed ferns and the angiosperms, the former are the best candidate for the ancestors of the angiosperms.

The third and final chapter of the first section deals with the evolution of characters. The topics covered are the determination of primitive characters and evolutionary trends, the characters of the primitive angiosperms, and finally a relatively lengthy discussion of the evolutionary morphology of the angiosperms beginning with habitat and growth habit, proceeding through leaf structure, vascular structure, inflorescences, and flower structure, and ending with fruits and seed dispersal.

The chapter ends with another discussion of the non-adaptive value of the majority of the characters of the higher angiospermous categories. A previous discussion of the same topic is to be found under the heading "Ecologic Niches, Survival Value, and Taxonomic Groups" in the first chapter. The author is well known for his somewhat unorthodox views concerning this subject and for various papers on orthogenesis in the angiosperms. He himself admits that this viewpoint is "not in favor among most modern students of evolutionary mechanisms, who feel that any evolutionary trend must ultimately be related to survival value". Perhaps this is the reason that the term



“orthogenesis is not to be found even once in the book, such phrases as “evolutionary momentum” or “predisposed evolution” being used in its place.

Evidently the author has not recognized the possibility that while the higher angiosperm categories *per se* may not have evolved in response to a certain adaptive zone (*fide* Simpson), the majority of the individual characters of the higher categories may themselves be adaptational and have their origin in natural selection.

Be that as it may, the discussion in the first part of the book (and indeed in the whole work) airs a number of good ideas which are expressed in a refreshing style. The following excerpts are taken as examples:

Evolutionary trends have all degrees of stability, from those which are so vague and subject to reversal that they can scarcely be recognized as trends, to those which fasten an inescapable grip on the destiny of the group. p. 62.

My nose tells me that the ethereal oils in the Magnoliidae are all chemically allied, and different from the ethereal oils found in other groups of flowering plants, but I have not found an account of the chemistry. p. 135.

To borrow an analogy which Stebbins has used in another context, evolutionary increase in parts of relatively small and definite number follows a goatpath, whereas reduction follows a paved highway. p. 313.

Anyone who has pushed a lawnmower should recognize the significance of the intercalary meristem in permitting a plant to withstand grazing. p. 344.

The last two-thirds of the book is a rather lengthy exposition of the author's system of angiosperms. Each recognized order is discussed, followed by a very useful synoptical key to the families of the order. This is followed by selected references of predominantly recent vintage.

Six subclasses of dicots and four monocots are recognized. The dicot subclasses and roughly their composition are as follows:



- 1) the Magnoliidae, which is a slightly restricted concept of the Englerian order Ranales.
- 2) the Hamamelidae, which is basically the Amentiferae.
- 3) the Caryophyllidae or Centrospermae.
- 4) the Dilleniidae, which is primarily the Englerian order Parietales with the ericaceous and ebenaceous Sympetalae thrown in along with a few other groups such as the Malvales, the Lecythidaceae, and the Capparales.
- 5) the Rosidae, which includes among others the sapindalean-geranialean complex, the Myrtales, the Euphorbiales, and the Umbellales.
- 6) the Asteridae, which includes the epigynous Sympetalae (Rubiaceae, Compositae, etc.) and the remainder of the hypogynous Sympetalae other than the Ericales and Ebenales (i.e., the Contortae and the Tubiflorae).

A few comments on certain specific points of the system will now be made.

It is evident that the author has made use of a number of personal communications and pre-publication manuscripts. It is unfortunate, however, that he was not able to discuss the Hamamelidaceae with Dr. A. L. Bogle, who for the past several years has been investigating the floral morphology and vascular anatomy of the family. Unpublished evidence available from this research strongly suggests that several genera of the family (e.g., *Distylium*, *Sycopsis*) possess bisexual pseudanthia (thus contradicting the key to the subclasses of Magnoliatae, p. 131), that the petals of the Hamamelidaceae are staminal in origin rather than of the probably more primitive tepalar origin (resulting from the differentiation of a primitively undifferentiated perianth of tepals into a petaloid upper part and a sepaloid lower part — as in the Magnoliaceae), that the flowers of the family were primitively apetalous, and that the supposedly primitive position of the genus *Disanthus* is at best questionable.

In light of this knowledge one might justifiably disagree with the author's statement that the Trochodendrales "have already progressed farther in floral reduction than the Hamamelidaceae, which have unmistakable (though somewhat reduced) petals, in contrast to the complete absence



of petals in the Trochodendrales". Conceivably the sepaloid perianth in *Tetracentron* may represent the vestiges of a once undifferentiated perianth while both the Trochodendrales and the *more primitive* members of the Hamamelidaceae are apetalous. Thus the problem of how to account for the petals in some members of the otherwise more advanced Hamamelidaceae vanishes when one considers that these petals may have arisen secondarily from apetalous ancestors by sterilization of stamens and do not represent petaloid vestiges of a once undifferentiated perianth.

The author's concept of the Rafflesiales as having "rather large to very large flowers" leads him to conclude among other things that a notable difference between that order and the Santalales is the size of the flowers. However, genera with very small flowers such as *Apodanthes* and *Pilostyles* immediately come to mind, even though the largest flower known is in the genus *Rafflesia*. Also this group is not composed solely of root parasites as the author implies, since certain members occur on the stem and minor branches of their host.

The author's treatment of the monocots is somewhat novel, but I am not in a position to comment on the Commelinidae and the Liliidae. The placement of the Juncales warrants some attention and is an interesting treatment of the group.

Unfortunately, the book is too short to treat familial relationships in any detail. It is to be regretted that a further treatment at the family level as is done in the latest book by the Russian phylogenist Takhtajan was not possible.

A chart showing the over-all classification at the ordinal level would be greatly desirable. Attention should also be called to the fact that families which the author does not accept are often not mentioned in the body of the discussion and their placement in the system can only be determined by reference to the list of families and orders at the end of the book.



The great number of personal communications and pre-publication manuscripts alluded to will certainly help to keep the book up-to-date longer than usual. There is a good coverage of new chemical data as they relate to phylogeny and the reader is especially referred to the excellent discussion of betalains in the Caryophyllidae (Centrospermae).

One of the major accomplishments of both Cronquist and Takhtajan is the erection of six rather large and for the most part probably natural subclasses within the dicots. The erection of these major divisions greatly aids one in grasping the prominent evolutionary trends within the dicotyledons. At last the major patterns are emerging and the work of the future phylogenist will consist mainly of deciding where to place a certain family or order here and there, i.e., it will be a matter of filling in the details and confirming previous ideas.

Although obviously opinionative, the author's frankness on certain morphological questions is quite refreshing. This includes his ideas on such topics as the following:

- 1) that the staminal fascicles in many of the Dilleniidae *sensu* Cronquist represent fusion and reduction rather than splitting and multiplication.
- 2) that the tendency in the Apocynaceae-Asclepiadaceae for a separation of the pistils from the base upwards is secondary rather than primary.
- 3) that the centrifugal maturation of the stamens in the Winteraceae (or in any family for that matter) is not phylogenetically significant; rather it is the centrifugal versus centripetal direction of the *initiation* of the staminal primordia which has phylogenetic significance.

In conclusion, the book should be read by every botanist who is interested in the latest thoughts concerning the phylogenetic treatment of the flowering plants. It is the most detailed treatment of a modern "Besseyan-based" system of angiosperm classification in English, being second only to the more detailed work of Takhtajan (unfortunately in Russian). The book should also serve admirably for plant taxonomy courses as a supplement to the usual



morphology and taxonomy texts. It will serve to put the orders and families of angiosperms into better perspective in the light of modern phylogenetic thought, which is something that is often sorely neglected or more or less omitted entirely in many introductory taxonomy courses. As the editor's introduction states, it serves to fill a place that was previously empty for the English reader.

In the final analysis, it combines the remnants of the out-worn system of Engler and Prantl with a modern re-interpretation of the Besseyan system. Like the phoenix arising from its ashes, it recreates in the light of modern knowledge another stage in the ever continuing search for the best system to reflect the evolutionary history of the angiosperms.

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